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RESEARCH PAPER

Visitors' Attitudes Towards and Willingness-to-Pay for Hypothetical Hoop Pine Plantations on the Pastoral Southern Atherton Tablelands, Australia

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Abstract The southern Atherton Tablelands comprises diverse green spaces—meadows, croplands, woodlots and rainforest—which are integrated into a large-scale tablelands landscape. This paper examines visitors' perceptions of the landscape of the southern Atherton Tablelands as a form of public good and their reaction to a hypothetical alteration to the landscape of the tablelands region by establishing small-scale hoop pine plantations on degraded lands. A survey conducted in 2005 indicated that the hoop pine plantations would not reduce the public enjoyment of the tablelands landscape. From the pairwise comparisons of vegetation types, it was found that the sample of tourists statistically equally preferred the 'grazing land' and the 'hoop pine plantation'. In contrast, the local residents were found to prefer the 'grazing land' to the 'hoop pine plantation', at the 5% significance level. From a double-bounded contingent valuation study, it was found that the tourists were willing to pay A$13.82 per room per visit on average to support the establishment of hoop pine plantations on the southern Atherton Tablelands whereas local residents were willing to pay A$7.86 per year for the next 5 years for the same project.

Keywords Green space · Environmental psychology · Pairwise comparisons · Contingent valuation

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Introduction

Forestry and agriculture have been the key industries shaping the landscape of tropical north Queensland in Australia since 1870s (Wet Tropics Management Authority 2003). Forestry in the region had developed through harvesting high-value native hardwood species—e.g., red cedar (*Toona ciliata*), Queensland kaur (*Agathis robusta*), Queensland maple (*Flindersia breyleana*), northern silky oak (*Cardwellia sublimis*) and hoop pine (*Araucaria cunninghamii*)—from the rainforest. The rate of forest clearing on the Atherton Tablelands was accelerated with the need to open up the rainforest for agricultural and dairy production by early European settlers (Ritchie 1995), and continued until an area of nearly one million hectares of tropical north Queensland was designated as the UNESCO's Wet Tropics of World Heritage Area (WTWHA) in 1988.

Following the World Heritage listing of the Wet Tropics rainforests, the supply for rainforest cabinet timbers contracted radically in tropical north Queensland (Lamb et al. 2001). To make up for the shortage of timber supply the Queensland government policy-makers have sought the plantation opportunities in which timber production is ecologically and economically feasible and the agricultural and pastoral landscape values can be maintained in the wet tropics. The soils and climate of the southern Atherton Tablelands have been found ideal for expanding the softwood plantation area. Geographic Information Systems studies have identified a large area of pasture land on the southern tablelands 'suitable and available' for forestry plantation. Among the native tree species, hoop pine has been the only species grown to any extent in state government forestry plantations, which were recently privatized. This conifer species has high quality timber but a long rotation; it has been grown for more than 60 years on the southern tablelands, at altitudes 600–1,100 metres above sea level.

Ironically, the land already cleared for cropping and dairying has since contributed to the regional growth of tourism (Huybers and Bennett 2002). Cropping land and rolling pastures are the integral visual components of the green landscape of the southern tablelands together with woodlots and crater lakes. It follows that an increase in one type of green space will inevitably result in a decrease in other types of green space of the tablelands. Even a small-scale change in land cover may affect the scenic amenity of the tablelands from the viewpoint of some members of the public (Staats and Wardt 1990).

Environmental personality differs across individuals' socio-economic characteristics (Cassidy 1997; Brady 2003). For example, some people may enjoy the pastoral landscape, and others prefer to see part of pasture area reforested. Therefore, one can question how conversion of part of pasture land into hoop pine plantations would affect the visual amenity values of the southern tablelands for the visitors.

This paper reports a study designed to examine visitors' perceptions towards the southern Atherton Tablelands landscape as a form of public good and to test whether public landscape users are willing to pay to assist the hoop pine plantations establishment. This paper first briefly explores past studies in the landscape amenity users' perceptions of green spaces and their willingness to pay (WTP) for the

availability of various types of green landscapes. Next, the key components of the aesthetic landscape in the southern Atherton Tablelands are described. The research methods are then explained and the survey questionnaire designed for this study is described. The visitors' perceptions of the study area and their preferred landscape type are then reported. Their support for the hoop pine plantation in monetary terms is next examined. Finally, the policy implications of the research results are drawn and the limitations for interpreting the research findings are discussed.

Studies of Preferences for Green Spaces

In the literature, much attention has been paid to green spaces in an urban context. Due to scarcity of land and natural amenities in urban areas, a number of non-market valuation case studies have found that proximity to urban green spaces such as public parklands, beaches and wetlands influence the market value of private properties (e.g. Mahan et al. 2000; Irwin 2002; Fleischer and Tsur 2003; Anderson and West 2006; Cho et al. 2008).

Many studies have been also devoted to estimating the amenity values attributed to rural green spaces. For example, Fleischer and Tsur (2000), Secchi (2007) and Kuminoff (2009) found that green space in the form of farmland in the urban–rural fringe not only produces agricultural products that are traded in the market, but also generates non-market aesthetic scenery. In other words, recreational and touristic visitors from urban areas are willing to incur costs to travel to appreciate the agricultural landscape. Waldo and Yoho (1977) even suggested that the owners of qualified agricultural real estate be provided property tax relief on the basis of the positive external services of their cropland. Some other studies (e.g. Brouwer and Slangen 1998; Rosenberger and Loomis 1999; Strijker et al. 2000; Doole and Pannell 2009) investigated the environmental or recreational value of ranch land. In particular, Rosenberger and Loomis (1999) measured the benefits to tourists associated with ranch open space in a resort area, Routt County, Colorado, which has been one of the popular tourist destinations in the USA for summer and winter outdoor recreation activities including camping, horse riding, mountain hiking and skiing.

These non-market valuation applications measured preferences for green landscapes, employing revealed preference methods including the travel cost method and the hedonic pricing method. Preferences for green spaces can also be elicited on a hypothetical basis through stated preference methods including the contingent valuation method (CVM) (e.g., Bowman et al. 2009; Caula et al. 2009) and choice modelling (e.g. Whitten and Bennett 2001). The pairwise comparison method (e.g. Champ and Loomis 1998; Lockwood 1998) has also been used to identify public preferences for green landscapes, presenting respondents with a series of binary choices and asking them to indicate a preference for one of them. Preference rating is another method that has been used aimed at identifying the characteristics of green space that people would prefer to see. Jensen and Preston (2005) conducted a landscape preference survey by interviewing 253 respondents, employing this method. The respondents of the study were asked to place a score at a 10-point scale on each of the photographs of a range of green landscapes

representing those of Caboolture Shire in the southeast Queensland, Australia. They found that a green pasture scene with sparse trees scored 8.3 out 10 on average, a eucalypt forest scene scored 8.1 and a cropland scene scored 5.9.

Measuring non-market values of natural areas and mapping out individual preferences for landscape types from surveys is a complicated and multidisciplinary task because different respondents ascribe different types of aesthetic values to the same landscape from different perspectives. Further, a *status quo* landscape may mean an amenity to some people and a disamenity to others. Likewise, a land-use change may translate into an aesthetic pleasure for some and an aesthetic displeasure for others.

There has been a great deal of environmental appreciation research into factors that influence a person's preferences for natural environments. Among others, the Kaplan and Kaplan (1989) preference model set forth four factors linking environmental cognition and environmental evaluation, namely mystery, complexity, legibility and coherence (Table 1). Mystery reflects the degrees to which a scene contains hidden information so that one is drawn into the scene to seek information. Complexity refers to the number and variety of elements in a scene. Legibility reflects how easily people can process the information available and understand what they see. Coherence refers to the organization of parts and how well the whole scene fits together (Cassidy 1997; Bell et al. 2000).

Brady (2003) pointed out that aesthetic evaluation is not restricted to cognitive states, but concerns primarily perceptual qualities and emotional and imaginative responses connected to them. Whether value components generated by human experience, cognition, perception and emotion are additively separable without arbitrary restriction has been debated in the literature. One can possibly design a comprehensive survey of landscape preferences in such a way that respondents are reminded of the full range of benefits they can consider in making their WTP judgments (Walsh et al. 1984). However, as Mitchell and Carson (1989) argued, if one assumes this is possible, the person makes an error called 'fallacy of motivational precision'—the error of assuming that respondents are aware of what motivates their value judgments to a high degree of precision.

Landscape Components of the Area Studied

The ingredients characterising the southern Atherton Tablelands landscape can be categorised as in Table 2. Green meadows on rolling hills, grazing livestock,

Table 1 Factors that influence environmental cognition and evaluation

Information availability	Informational outcome	
	Understanding	Exploration
Immediate	Coherence	Complexity
Inferred or predicted	Legibility	Mystery

Source Kaplan (1987)

Table 2 Landscape ingredients in the southern Atherton Tablelands

Category	Ingredient
Farming land	Meadows and agricultural cropland (e.g. sugarcane, corn, peanuts, avocado, tobacco, mango and tea tree)
Livestock	Cattle
Forest	World Heritage rainforest and wildlife, patches of remnant native forests and forestry plantations
Historical tablelands townships	Yungaburra, Malanda, Millaa Millaa, Atherton, Kuranda
Natural attractions	Craters and lakes (Mount Hypipamee Crater, Lake Tinaroo, Lake Barine, Lake Eacham), waterfalls (Barron Falls, Milla Milla Falls), monumental trees (Curtain Fig Tree, Cathedral Fig Tree)

Source Qld DPI (2008) and Ritchie (1995)

agricultural crops and sparse native or planted woodlots are all important components shaping the visual landscape of the region studied. Agriculture including dairy farming is a major industry on the southern Atherton Tablelands such that the only patches of native forest now exist mostly on those areas too steep for farming (Malcolm et al. 1999).

Many inspiring natural attractions are located on the area studied including Barron Falls and the Curtain Fig Tree. These attractions can be said to play the role of mystery factor in the Kaplan and Kaplan preference model. Further, the landscape of the tablelands is culturally, topologically and ecologically complex enough to provide the visitors with an opportunity to experience the diversity of the natural environmental setting. The expanse of pastoral and crop land is adjacent to a vast WTWHA, which is in turn next to the Great Barrier Reef, a well-known marine World Heritage Area. The Curtain Fig Tree is located near the historic township of Yungaburra whereas Barron Falls is situated in the WTWHA. Thanks to the tropical climate, the fertile tablelands coherently present rich green space all year round whereas most other parts of Australia are arid or semi-arid in climate. The scenic amenities of the tablelands are readily evident and can easily be viewed by driving or taking a bus tour following winding roads on rolling hills from town to town or from a natural focal point to another such as waterfalls, lakes and giant trees.

Figure 1 shows the locations of various natural attractions and local towns in the study area. The southern section of Atherton Tablelands on this map is bordered approximately between Atherton to the north and Ravenshoe to the south and running east to the shaded area of the WTWHA.

Research Method

A modified pairwise comparison method was used to identify visitors' preferences amongst several landscape types representing the southern tablelands, with double-bounded CVM to measure the preference for a hypothetical hoop pine plantation in monetary terms. Incorporating these preference research methods, a survey

Fig. 1 Map of the Atherton Tablelands area. *Source* Tropical Tablelands Tourism (2005)

questionnaire was designed for face-to-face interviews with visitors to the tablelands.

The potential interviewees were classed as either tourists or local residents because, as the literature (e.g., Regenberger 1998; Vail and Heldt 2004; Soguel et al. 2008) suggested, these two groups were expected to have distinctive preferences for environmental settings. The criterion to distinguish tourists and local residents was their residential place of origin; visitors from outside the Far North Queensland Statistical Division (running from Townsville in the south to Cape Tribulation in the north) being classified as 'tourists' to the southern Atherton Tablelands.

Unlike the conventional paired comparison method as described by Champ and Loomis (1998) in which survey participants are forced to choose either Option A or Option B, the participants in this study were allowed to indicate they cannot make a choice or they equally prefer either of two options. Further, the respondents could indicate the extent to which they preferred one option over the other. From the choices made by participants, however, it cannot be inferred whether they viewed a given pair of landscapes as conflicting, independent or complementary. Nor does the

pairwise comparison method used in this study enable the researchers to infer whether participants were willing to make tradeoffs between a pair of options. To address these problems in part, contingent valuation questions were presented to the participants.

The WTP estimate sought in these valuation questions is a Hicksian measure of welfare, namely the maximum WTP for a hoop pine plantation scenario. However, the double-bounded responses do not allow the researchers to elicit the maximum WTP amount straightforwardly. Alternatively, the following logistic probability functions (Hanemann et al. 1991) need to be estimated:

$$P_{\mathrm{i}}^{\mathrm{yy}} = \Pr(B_{\mathrm{i}}^{\mathrm{Higher}} \leq \max WTP_{\mathrm{i}}) = 1 \Big/ [1 + \exp[-(b_0 + b_1 B_{\mathrm{i}}^{\mathrm{Higher}})]]s \tag{1}$$

$$\begin{aligned} P_{\mathrm{i}}^{\mathrm{yn}} &= \Pr(B_{\mathrm{i}} \leq \max WTP_{\mathrm{i}} < B_{\mathrm{i}}^{\mathrm{Higher}}) \\ &= \{1 \Big/ [1 + \exp(b_0 + b_1 B_{\mathrm{i}}^{\mathrm{Higher}})]\} - \{[1/[1 + \exp(b_0 + b_1 B_{\mathrm{i}})]]\} \end{aligned} \tag{2}$$

$$\begin{aligned} P_{\mathrm{i}}^{\mathrm{ny}} &= \Pr(B_{\mathrm{i}}^{\mathrm{Lower}} \leq \max WTP_{\mathrm{i}} < B_{\mathrm{i}}) \\ &= \{1/[1 + \exp(b_0 + b_1 B_{\mathrm{i}})]\} - \{1/[1 + \exp(b_0 + b_1 B_{\mathrm{i}}^{\mathrm{Lower}})]\} \end{aligned} \tag{3}$$

$$P_{\mathrm{i}}^{\mathrm{nn}} = \Pr(B_{\mathrm{i}}^{\mathrm{Lower}} > \max WTP_{\mathrm{i}}) = 1/[1 + \exp(b_0 + b_1 B_{\mathrm{i}}^{\mathrm{Lower}})] \tag{4}$$

where B_{i}, $B_{\mathrm{i}}^{\mathrm{Higher}}$and $B_{\mathrm{i}}^{\mathrm{Lower}}$ denote, respectively an initial bid by the *i*th respondent, a higher bid presented when the respondent says 'yes' to the initial bid, and a lower bid presented when the respondent says 'no' to the initial bid. In the logit model, the dependent variable is the probability that an individual is willing to pay a particular dollar amount for any scenario-specific environmental improvement with reference to their maximum WTP. The parameters, b_0 and b_1, of the logit model can be estimated, maximising the following log-likelihood function embracing the four components expressed by Eq (1) through to (4), given a sample of N respondents.

$$L = \sum_{\mathrm{i}}^{N} (d_{\mathrm{i}}^{\mathrm{yy}} \log P_{\mathrm{i}}^{\mathrm{yy}} + d_{\mathrm{i}}^{\mathrm{yn}} \log P_{\mathrm{i}}^{\mathrm{yn}} + d_{\mathrm{i}}^{\mathrm{ny}} \log P_{\mathrm{i}}^{\mathrm{ny}} + d_{\mathrm{i}}^{\mathrm{nn}} \log P_{\mathrm{i}}^{\mathrm{nn}}) \tag{5}$$

where d_{i}* is a binary response category for the *i*th respondent. There are four categories of possible responses associated with the double-bounded dichotomous contingent valuation: (yes, yes), (yes, no), (no, yes), and (no, no). In Eq. (5), $d_{\mathrm{i}}^{\mathrm{yy}}$ takes a value of 1 if the respective response of the ith respondent is (yes, yes) and 0 otherwise. Likewise, $d_{\mathrm{i}}^{\mathrm{yn}}$ takes a value of 1 if the ith response is (yes, no) and 0 otherwise, and so on.

The overall goodness of fit of the double-bounded logit model can be indicated by the χ^2 statistic (Harpman and Welsh 1999), which is defined as two times the difference in log-likelihoods, i.e.:

$$L_{\mathrm{R}} = 2(LogL_{\mathrm{U}} - LogL_{\mathrm{R}}) \tag{6}$$

where $LogL_{\mathrm{U}}$ denotes the value of the log-likelihood function maximised from the unrestricted model, and $LogL_{\mathrm{R}}$ denotes the estimated value of the restricted log-likelihood function. When the χ^2 statistic is smaller than the critical value for a

given number of degrees of freedom, the null hypothesis cannot be rejected that the coefficients of the restricted variables are all zero.

Development of the Survey Questionnaire

A questionnaire was designed to gather the Information needed to identify visitors' landscape perceptions and preferences, and their WTP for the environmental benefits that can be generated by hypothetical hoop pine plantations on the pastoral southern tablelands. The two-page A-4 survey questionnaire consisted of three main sections: a section of questions related to visitors' general perceptions towards the characteristics of the tablelands landscape; a set of questions to make pairwise comparisons of several land-use types for the southern tablelands; and contingent valuation questions intended to elicit visitors' WTP amounts for a hypothetical hoop pine plantation establishment.

Pilot testing of a draft questionnaire was conducted at a public picnic park in the Maleny town and Mary Cairncross Park, which is located near the Glasshouse Mountains in the Sunshine Coast hinterland region with landscape characteristics similar to those of the Atherton Tablelands. Interviewing 17 visitors to the parks, the pilot test focused on three issues: namely, the time required for each respondent to complete the questionnaire; the clarity of the format of the pairwise comparison questions; and the plausibility of the CVM questions. Findings during and after the pilot survey were incorporated into the final form of the survey questionnaire, the main sections of which are described as follows.

Visitors' Perceptions Towards Green Landscapes

A question was included asking respondents to nominate three most inspiring scenic features they had experienced during travel on the southern tablelands. This was followed by a question asking respondents to indicate the importance of various elements in determining the beauty of the tablelands landscape, on a 5-point Likert scale. Several predetermined elements that the researchers thought may constitute a holistically preferable landscape were presented for the respondents to rate each of them separately: namely, grassland, mixed rainforest trees, exotic trees, cropland and wildlife. The section next asked respondents to indicate how hypothetical tree plantation establishment would affect their enjoyment of the landscape, on a 5-point Likert scale with 3 being the neutral.

Pairwise Preference Comparisons of Land-use Types

The pairwise comparison section of the questionnaire presented respondents with four distinct land-use types, namely degraded land,[1] hoop pine plantation, mixed

[1] Although the definition of 'degraded land' is open to wide interpretation, this study adopted the definition used in the Australian Land Use and Management (ALUM) classification system, in which degraded land is defined as 'land that is severely degraded (e.g., from soil erosion, salinity, or weed or shrub invasion) and is not under active rehabilitation' (Bureau of Rural Sciences 2006, p. 23).

	Strongly prefer ←		Neutral		→ Strongly prefer	
Degraded land	○	○	○	○	○	Hoop pine plantation
Hoop pine plantation	○	○	○	○	○	Mixed rainforest plantation
Mixed rainforest plantation	○	○	○	○	○	Grazing land
Grazing land	○	○	○	○	○	Degraded land
Grazing land	○	○	○	○	○	Hoop pine plantation
Mixed rainforest plantation	○	○	○	○	○	Degraded land

Fig. 2 The format of pairwise comparison questions

rainforest plantation and grazing land. Photos of these land types were presented, and respondents were requested to compare one pair of landscape photos at a time. With four types of land-use, six pairs of landscape photos were presented. In each paired comparison, the respondents were asked to indicate their preferred land-use type by ticking one of five circles provided in a row between two choices as shown in Fig. 2.

Double-Bounded Contingent Valuation Questions

The contingent valuation section of the questionnaire introduced a hypothetical land-use change: Respondents were informed that: It has been proposed that hoop pine trees be planted on an area of about 500 ha of degraded land. Hoop pine is an Australian native conifer and a rapidly growing high quality timber species, and that hoop pine plantations would generate a variety of environmental public benefits including wildlife habitat protection, carbon sequestration, and watershed protection from soil erosion. The section reminded respondents that the hoop pine plantations would result in a permanent change in the vista of the southern Atherton Tablelands. Finally, the section asked respondents if they would be willing to pay for the land-use change.

A *landscape improvement fund* was chosen as the payment vehicle for both tourists and local residents in this contingent valuation application. Tourists from outside north Queensland were framed to imagine staying in commercial accommodation where they would be charged an *extra fee per room per visit* relative to what they would otherwise pay. In contrast, local residents were asked if they were prepared to contribute a given dollar amount per year for the next 5 years to support the hoop pine plantations project.

The double-bounded bidding technique was used where the respondents were presented with two bid amounts, i.e., an initial bid and a higher bid or a lower bid. Those respondents who stated that they were willing to pay an initial bid were then presented with a higher amount whereas those who rejected an initial bid were then offered a lower bid. Any respondents who rejected both amounts presented to them were asked to state any reasons for rejection. To allow a wide range of variation for the statistical purposes, four distinct sets of WTP bid amounts as presented in

Table 3 Four sets of WTP bids for the hoop pine plantation program (in Australian dollars)

Version	First bid	Higher bid	Lower bid
1	5	7	3
2	10	15	5
3	20	30	10
4	40	50	30

Table 3 were combined with each of the two payment modes.[2] To ensure that the four sets of bid amounts was equally represented, copies of four versions of questionnaire were handed out by turns to each of tourist and local resident samples.

Towards the end of the survey questionnaire after the WTP questions, several follow-up questions were posed in order to obtain data on the socio-economic characteristics of the respondents, in terms of gender, age, education and income. With respect to the income variable, four broad ranges—less than $25,000, $25,000–$50,000, $50,000–$100,000 and more than $100,000—of annual household income in Australian dollars were presented for the respondents to tick one of them. This interval format was used with an intention not to make the respondents feel that the income question was an invasion into their privacy, which was indicated during the pilot survey.

Survey Procedures and the Characteristics of the Respondents

The interviewees were randomly selected from those who happened to visit the survey sites at the time when teams of interviewers undertook the fieldwork. The survey sites were limited to six 'hot spots' in the southern Atherton Tablelands—Lake Eacham, Lake Barrine, Mount Hypipamee National Park, Lake Tinaroo, Yungaburra historic village and Barron Falls. In the vicinity of these visiting points were restaurants, picnic benches or viewing platforms where people would relax and therefore be willing to take part in the survey when approached by the interviewers.

The survey was conducted between 22 August and 6 October 2005.[3] Two teams of interviewers in uniform shirts with the University of Queensland or Rainforest CRC logo printed on them approached about 550 visitors during the survey period on the hot spots and asked if they could provide the interviews with information about their perception of and attitudes towards the visual landscape of the southern Atherton Tablelands, by filling out the survey questionnaire provided. The interviewers collected 506 completed questionnaires, of which 285 respondents were classified as tourists and of 221 as local residents. Although the exact number

[2] A copy of one of the tourist versions of the survey questionnaire is presented as an Appendix.

[3] While 4 years have passed between carrying out the survey and preparing this paper, the survey results remain relevant to the forest policy environment in the north Queensland, with one major proviso. It was announced in May 2010 that all government plantations in Queensland would be sold to Hancock Forestry Plantations, so policies towards new plantings can be expected to change. The delay in publication was in part due to on-going research into hoop pine plantations in the study area and political sensitivity.

Table 4 Duration of living in the Far North Queensland statistical division by the local residents

Duration (years)	<5	5–10	11–20	>20	Missing	Total
Frequency	50	29	53	91	6	221
Relative frequency (%)	22.6	13.1	24.0	37.6	0.3	100

of visitors approached by the interviewers was not recorded at the time of survey, the approximate response rate was greater than about 90% (506 out of about 550), which was believed to be sufficiently high to ignore the possibility of non-response bias.

Those who indicated to be below 18 of their age at the time of survey were not asked to filled out the survey questionnaire, the reason being they would most likely not to have a independent source of income. Also, those who indicated to belong to the same household were not allowed to complete the questionnaires separately. The rationale of this was to minimise the possible occurrence of double counting or overestimation of the mean WTP amounts (Quiggin 1998).

Table 4 presents the distribution of the local resident sample in terms of the duration of their living in the area of the Far North Queensland Statistical Division. It was found that about 62% of the local residents had lived in the region more than 10 years.

The origins of tourists were categorised into three regions: any part of Queensland outside the Far North Queensland Statistical Division; any other states or territories rather than Queensland; and overseas. Table 5 reveals that about 45% of the sample of tourists turned out to be international visitors. All these categories combined, it was found that the tourist respondents had made previous visits to the southern Atherton 1.08 times on average.

All respondents were requested to indicate other places they intended to visit or had visited in far north Queensland. The names of these places are listed in Table 6.

Table 5 The origin of the tourist respondents

Origin	Queensland	Elsewhere in Australia	Overseas	Total
Frequency	60	96	129	285
Relative frequency (%)	21.1	33.7	45.3	100

Table 6 Number of respondents who had visited or intended to visit other places in north Queensland

Group	Total number of respondents	Place					
		GBR	Daintree	Kuranda	Cairns	Port Douglas	Others
Tourists	224	179	148	132	20	14	107
Residents	44	21	14	21	2	0	0

Frequencies for places visited or intended to visit do not sum to sample sizes because of multiple responses

A total of 224 tourists (or 78.6% of the tourist sample) responded that they intended to visit or had visited one or more places in north Queensland, indicating that they had travelled to the southern Atherton Tablelands as part of an extensive journey to north Queensland, often including a visit to the Great Barrier Reef (GBR). In contrast, the number of the local residents who responded that they had already visited or were going to visit these other places in conjunction with the trip to the southern Atherton Tablelands was much lower with a total of 44 (or 20% of the local resident sample).

Visitors' Perceptions of the Landscape Elements of the Southern Atherton Tablelands

Table 7 summarises the responses to the question concerning the three most attractive features visited on the southern Atherton Tablelands. It was found that both tourists and local residents saw the tropical rainforest as the most attractive landscape component of the tablelands, followed by pastoral landscape, lakes and waterfalls.

Interestingly, although there was little difference between tourists and local residents in terms of selection and overall ranking of natural features, there was considerable difference between groups in terms of relative frequently or mentions of each of these scenic features. Of the 285 tourists, 157 (55%) regarded rainforest as one of the three most important landscape components whereas only 61 out of 221 local residents or 28% of the local residents recognised rainforest in the same view. Similarly, 113 tourists (40%) thought grassy vegetation and grazing livestock on rolling hills to be one of the three most impressive landscape elements whereas only 50 out of 221 (23%) local residents responded in the same fashion.

In addition to nominating most impressive landscape components on an open-ended basis, respondents were asked to rate each of a set of 6 predetermined landscape elements in terms of the importance to their perception of an aesthetically beautiful landscape in general. A 5-point Likert scale was employed, with one representing 'very unimportant' through five being 'very important'. Table 8 summarises the results. Interestingly, applying *t*-tests to mean responses (reported in Table 8) did not identify any statistically significant difference in the ratings of importance of these landscape elements between tourists and local residents.

Table 7 Frequency of being named as one of three most attractive scenic features of the southern Atherton Tablelands

Group	Feature					
	Rainforest	Pasture	Lakes	Waterfalls	Wildlife	Crops
Tourists	157	113	94	74	59	33
Residents	61	50	46	19	4	5
Total	218	163	140	91	63	38

The total frequency exceeds the number of respondents, due to multiple responses

Table 8 Evaluation of the importance of rural landscape elements on a 5-point Likert scale

Group	Element				
	Grassland	Rainforest trees	Exotic trees	Cropland	Wildlife
Tourists	3.3	4.3	3.3	2.5	4.5
Residents	3.5	4.5	3.1	2.9	4.6

Both groups indicated that mixed species rainforest trees and wildlife were highly important ingredients to shape an attractive rural landscape. Tourists and local residents rated 'grassland' at 3.3 and 3.5, respectively. It is notable that grassland (i.e., pasture) was perceived as less important a landscape component than rainforest, but more important than cropland. These results were, by and large, consistent with what was found by the open-ended question.

Respondents were requested to rate how the establishment of tree plantations on the southern Atherton Tablelands would affect their enjoyment of the current landscape. Again, a 5-point Likert scale was adopted, with 1 representing 'strongly negatively' through to 5 being 'strongly positively'. The modal class of both respondent groups was at the neutral rate of 3, as presented in Table 9. However, it was found that the sample means of the ratings were statistically higher than 3 at the 5% significance level. This result implied that tree plantations would, in general, enhance the landscape amenity of the southern tablelands for visitors.

Findings from the Pairwise Comparisons of Land-use Types

To analyse the pairwise comparisons, the responses in each comparison were scaled over the range of 1–5, where 5 denotes that the right-hand-side vegetation type in the first column of Table 10 is strongly preferred, 1 denotes that the left-hand-side type is strongly preferred, and 3 means indifference between types. Table 10 reports the sample means of responses by tourists and local residents. To determine whether the population means are statistically different from 3, t tests were conducted with the null hypothesis that the population mean is equal to three for each pairwise comparison. Symbolically, the null and two-tailed alternative hypotheses can be expressed as:

Table 9 Impact of hypothetical tree plantations on the visitors' enjoyment of the current landscape on a 5-point Likert scale

Group	Sample mean	Distribution of ratings						Total
		1	2	3	4	5	Missing	
Tourists	3.19	40	35	82	75	46	6	285
Residents	3.50	24	15	67	45	62	7	221
Total	3.33	64	50	149	120	110	13	506

Table 10 Summary of pairwise comparisons of land-use types

Pair of landscape types	Tourists		Residents	
	Sample mean	*t* statistic	Sample mean	*t* statistic
Degraded land vs. hoop pine plantation	3.70	9.648	3.70	7.958
Hope pine plantation vs. mixed rainforest plantation	4.24	20.721	4.35	19.753
Mixed rainforest plantation vs. grazing land	2.35	−7.859	2.43	−5.662
Grazing land vs. degraded land	2.08	−13.411	1.88	−14.692
Grazing land vs. hoop pine plantation	2.99	−0.186	2.58	−4.437
Mixed rainforest plantation vs. degraded land	1.71	−18.797	1.64	−18.269

$$H_0 : \mu_i = 3$$
$$H_1 : \mu_i \neq 3$$

where i indicate the above-mentioned pairs of comparisons and μ is the population mean value on the Likert scale for each evaluation question. If a particular option is preferred, the estimated mean value of rating for the option should not be equal to three.

It was found that respondents strongly preferred 'mixed rainforest plantation' to any other land-use types. This result that visitors might perceive mixed species rainforest as natural and close to the forgone original landscape in the region was not unexpected, given that the southern Atherton Tablelands encompasses the WTWHA.

Interestingly, the sample of tourists indicated they equally prefer 'grazing land' and 'hoop pine plantation' with the sample mean of 2.99. This result indicates that 'hoop pine plantation' and 'grazing land' are almost equally contributing to the amenity of the tablelands landscape. However, it cannot be inferred that the aesthetic pleasure of the tourist group, currently arising from the pastoral landscape, would not be compromised if some pasture land was replaced by hoop pine plantations.

The local residents were found to prefer 'grazing land' to 'hoop pine plantation', at the 5% significance level, with the sample mean value of 2.58. It was evident, although not overwhelmingly, that there were some local residents who did not favour 'hoop pine plantation' against 'grazing land'.

As for 'degraded land', both the tourist group and the local resident group supported the idea of rehabilitating this type of land into mixed rainforest, well managed pasture land or hoop pine plantation in this order of preferences. It should be noted, however, that some respondents indicated their preference for 'degraded land' over the other land-use options despite a negative connotation attached to the term 'degraded'.

Estimation of Visitors' Willingness-to-Pay for Hypothetical Hoop Pine Plantations

Each respondent was asked if he or she was willing to pay a dollar amount, and then whether they were willing to pay a higher amount or a lower amount, depending on

Table 11 Summary of the responses to the WTP questions to support the hoop pine project

Visitor type	Bid amount			Frequency of the responses to the double-bounded questions				Total
	1st	Lower	Higher	(Yes, Yes)	(Yes, No)	(No, Yes)	(No, No)	
Tourist	5	3	7	30	12	9	20	71
	10	5	15	19	17	15	22	73
	20	10	30	12	9	30	21	72
	40	30	50	10	7	11	41	69
Sub-total				71	45	65	104	285
Resident	5	3	7	11	4	7	33	55
	10	5	15	24	4	4	23	55
	20	10	30	10	3	12	32	57
	40	30	50	14	1	8	31	54
Sub-total				59	12	31	119	221

whether the response to the first bid was 'yes' or 'no'. Table 11 summarizes responses to the double-bounded WTP questions. A total of 181 (63.5%) of the tourists were willing to pay to support the establishment of hoop pine plantations on the southern Atherton Tablelands whereas 102 local residents (43%) were willing to pay for the same project.

A high proportion of respondents whose answers were (no, no) to the double-bounded contingent valuation questions is not inconsistent with a finding from the pairwise comparisons of land-use types that there were some respondents who preferred the 'degraded land' option over 'hoop pine plantation'. Among other reasons why a large number of respondents were unwilling to contribute to the plantation project, the compulsory form of payment and the choice of the hoop pine tree species were pointed to as major reasons. The existence of the protesting responses warns that the WTP estimates should be interpreted conservatively.

The parameters in the log-likelihood function expressed in Eq. 5 were estimated separately for tourists and local residents with the LIMDEP statistical package. The maximum log-likelihood models were estimated with and without a priori individual characteristic variables including age, gender, education and income. The estimated models are summarised in Table 12. From the log-likelihood ratio test based on Eq. 6, it was found that the observed χ^2 values of 4.53 and 7.40 did not exceed the critical χ^2 values of 14.86 with 4 degrees of freedom and 12.84 with 3 degrees of freedom respectively at the 5% significance level. Therefore, the null hypothesis could not be rejected at the 5% significance level that the estimated coefficients for the restricted variables in each of the double-bouded logit models for tourists and local residents are all zero, indicating these variables did not influence the contingent valuation responses.

Interestingly, the coefficient against the income variable in the logit model for tourists was found statistically negligible whereas it was not the case for local residents. This result can be interpreted that the income levels of the local residents influenced their WTP responses to some extent with the expected positive sign. The

Table 12 Results of the double-bounded logit models for tourists and local residents

Statistic or variable	Tourists		Residents	
	Restricted model	Unrestricted model	Restricted model	Unrestricted model
Constant (b_0)	1.222 (7.124)	1.256 (5.175)	0.393 (2.286)	0.420 (1.954)
Bid (b_1)	−0.088 (−14.210)	−0.089 (13.938)	−0.050 (−8.544)	−0.050 (−8.485)
Age	–	0.005 (0.107)	–	0.000 (0.030)
Gender[a]	–	0.000 (0.495)	–	0.007 (0.028)
Education[b]	–	0.001 (1.121)	–	0.000 (0.254)
Income	–	−0.000 (−0.021)	0.002 (2.413)	0.002 (2.403)
Mean WTP (A$)	13.82	–	7.86	–
Number of observations	285	285	221	221
Maximum log-likelihood	−407.819	−405.555	−257.241	−260.941
χ^2 (likelihood ratio)	4.53		7.40	

The figures in parentheses are *t* statistics

[a] A dummy variable (male = 1, female = 0)

[b] A dummy variable (tertiary = 1, less than tertiary = 0)

income levels were coded as 1 to 4 in ascending order, corresponding with the four brackets of annual household income presented in the questionnaire.

With logit models, the mean WTP is given by minus 1 times the intercept divided by the slope coefficient of the indirect utility function (Hanemann et al. 1991), i.e. $-(b_0/b_1)$. The estimated mean WTP amounts for the hypothetical hoop pine plantations on the southern Atherton Tablelands amounted to A$13.82 per room per visit and A$7.86 per year for the next five years for tourists and the local residents, respectively.

The *t*-statistic of $(WTP_T - WTP_R)$, where WTP_T and WTP_R denote the mean WTP estimated for the tourists and residents respectively, could be obtained from the stacked dataset in order to test whether the difference between the mean WTPs across the two groups of respondents are statistically different from zero. However, it is clear that the measurement unit (A$ per room per visit) of the mean WTP estimated for tourists is not exactly same as that (A$ per year for the next 5 years) for local residents. Thus, the estimation of the *t* value of $(WTP_T - WTP_R)$ for this purpose would be statistically inappropriate. In other words, the mean WTPs should not be used to determine which group of the respondents was more supportive of the hypothetical hoop pine plantation scenario.

Conclusions and Discussions

The call for appropriately managing natural resources through balancing the conflicting interests of affected parties continues to offer a challenge to natural

resource managers. The southern Atherton Tablelands has been a case that highlights this type of challenge because the tablelands is one of the most popular tourist destinations in Australia. Although most of the tablelands is privately owned, its unique agricultural tablelands landscape generates a form of positive externality for visitors. Thus, it is important, from a social perspective, to identify how a land-use change in the southern tablelands would affect the interests of the visitors. To this end, this study has examined visitors' preferences for vegetation types and their willingness-to-pay for hypothetical hoop pine plantations in the southern section of Atherton Tablelands.

The visitor attitude and WTP study revealed that visitors to the southern Atherton Tablelands considered green space in the form of pastures as a highly important element in their perception of a beautiful rural landscape. On the other hand, from the pairwise comparison analysis, tourists and local residents were found to differ in their respective views concerning 'grazing land' versus 'hoop pine plantation'. While the tourists' preference was found indifferent between the two vegetation types, the local residents' collective preference leaned towards pasture landscape.

The contingent valuation revealed that the majority of the tourists interviewed were willing to pay to support the establishment of hoop pine plantations on the more degraded pasture land of the study area, their mean WTP being A$13.82 per room per visit. The estimated mean WTP from the local resident sample amounted to A$7.86 per year for the next five consecutive years.

A clear policy implication that can be drawn on these findings is that the more degraded farm land, with weed infestation, is an ideal candidate for reforestation. Degraded land is inherently less productive than prime pasture land, but still well suited to forestry with a native long rotation species having high environmental value. Another implication of this study is that the well maintained grazing land could be left as is. This study found that both the tourist group and the local resident group indicated they did not prefer 'hoop pine plantation' over 'grazing land' type of green space. Further research, however, needs to be carried out to locate a more precise mix of vegetation types that is preferred by the visitors to the southern tablelands.

Finally, a remark should be made about a drawback associated the sampling procedure known as convenience sampling or on-site sampling adopted by this research. Because the local resident sample only included those residents who visited the 'hot spots' at the time of conducing the survey, the sample was not necessarily representative of the population of local residents. In other words, frequent local visitors were more likely to be sampled and therefore those more interested in the study area were likely to be over-represented in the data. As a result, a sampling bias may have occurred in the estimated WTP for the hoop pine plantation scenario. This concern could only be fully overcome by using a population-based sample rather than an on-site sample of visitors. The possibility of generating sampling bias also holds true of the tourist visitors who, unlike local residents, constitute what is known as an unknown population. Therefore, the mean WTP estimates in this research should not be generalized to the respective population in a potential benefit-cost analysis.

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Appendix

THE UNIVERSITY OF QUEENSLAND AUSTRALIA

Rainforest CRC

TOURIST SURVEY, SOUTHERN ATHERTON TABLELAND

This survey is being conducted by Dr Jungho Suh (School of Economics), Dr Edson Leite (School of Natural and Rural Systems Management) and Mr Robert Lwanga (School of Natural and Rural Systems Management), researchers from The University of Queensland. We would like your help. We need information about your perception of and attitudes towards the *visual landscape* of the southern Atherton Tableland, which you see when you are driving through any part of the route of Yungaburra–Malanda–Milaa Milaa. Could you please take a little while to answer some of our questions? Your answers will be treated as confidential and used only for scientific purposes.

PLEASE TELL ME ABOUT YOUR TRIP.

Q1. Where do you live?

☐ Queensland ☐ elsewhere in Australia ☐ overseas

Q2. Was this trip to the southern Atherton Tableland undertaken as part of

☐ a vacation ☐ a business trip ☐ a visit to relatives or friends

other (please specify)_____ ?

Q3. Is this trip to the Atherton Tableland part of a longer trip?

☐ yes ☐ no

If yes, what other main destinations have you visited or do you intend to visit?

☐ Great Barrier Reef ☐ Daintree ☐ Kuranda

☐ others (Please specify) a)_____, b)_____,

Q4. How many previous visits have you made to the southern Atherton Tableland? ☐ none ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ more than 4.

WHAT DO YOU THINK OF THE SOUTHERN ATHERTON TABLELAND?

Q5. Do you find the southern Atherton Tableland rural landscape similar to that in any other part of the world you have visited? ☐ yes ☐ no.
If yes, what areas? _____.

Q6. How does the natural attractiveness of the southern Atherton Tableland compare to other landscapes that you have seen?

(1= least beautiful; 5= most beautiful)

1	2	3	4	5

Q7. What do you consider the most **ATTRACTIVE** features of the Atherton Tableland landscape?
a)_____.
b)_____.
c)_____.

Q8. What features or qualities of the southern Atherton Tableland **DETRACT** most from the satisfaction you derive from your trip?
a)_____.
b)_____.
c)_____.

Q9. Please rate the importance of the following characteristics in determining a beautiful rural landscape.

(1 = not important and 5 =very important)

	1	2	3	4	5
Open space					
Mixed rainforest trees					
Exotic trees					
Grazing animals					
Cropland					
Wildlife (birds and other animals)					

Q10. It has been suggested that more land on the Tableland is suitable for tree plantations. How would more trees affect your enjoyment of the landscape? **(1= very negative, 2, 3, 4, 5=very positive).**

1	2	3	4	5

Q11. If you agree with the idea of planting more trees for future timber harvesting, where should more trees be planted?

☐ on the steeper land only ☐ on all land

Q12. Please indicate which of each pair of the two landscape scenarios below you prefer, by ticking one of circles in each row. Photographs are provided.

	Strongly prefer ←			Neutral	→ Strongly prefer	
Degraded land	○	○	○	○	○	**Hoop pine plantation**
Hoop pine plantation	○	○	○	○	○	**Mixed rainforest plantation**
Mixed rainforest plantation	○	○	○	○	○	**Grazing land**
Grazing land	○	○	○	○	○	**Degraded land**
Grazing land	○	○	○	○	○	**Hoop pine plantation**
Mixed rainforest plantation	○	○	○	○	○	**Degraded land**

LANDSCAPE VALUATION

The Atherton Tableland was first cleared for dairying and cropping about 100 years ago. Over time, some of the land has deteriorated, with pastures replaced by poorer grasses and weeds. This land is well suited to growing trees.

It is proposed that an area of about 500 ha of degraded land on the southern Atherton Tableland be planted to Hoop Pine (*Araucaria cunninghamii*) trees. This is an Australian native conifer tree species, grown in plantations by the Queensland Department of Primary Industries, which has high quality timber.

The Hoop Pine plantations would result in a permanent change in landscape appearance (with annual small areas logged after about 40 years and immediately replanted), and produce timber and provide wildlife habitat, watershed protection and carbon sequestration benefits.

It is hypothesized that the visitation cost to the area were to be increased per person, **through a supplementary accommodation charge** to be placed in a **Landscape Improvement Fund**.

Q13. Would you agree to an increase of **$20** in the accommodation charge per room per visit to the Atherton Tableland and be willing to pay this amount when you visit north Queensland to support this project?

☐ yes

What if the cost to you turned out to be higher? Would you agree to an increase of **$30** in the accommodation charge per room per visit and be willing to pay this amount to support this project?

☐ yes ☐ no

☐ no

What if the cost to you turned out to be lower? Would you agree to an increase of **$10** in the accommodation charge per room per visit and be willing to pay this amount to support this project?

☐ yes ☐ no

Q14. (**Only if you ticked no-no in Q13**), why are you not willing to pay **$3** to support this project? Please print your answer briefly.

_____

_____

_____

Q15. Gender: ☐ M ☐ F

Q16. Age class:

☐ 20 or less ☐ 21–30 ☐ 31–40 ☐ 41–50 ☐ 51– 64 ☐ 65 or more

Q17. Highest level of formal education:

☐ primary ☐ secondary ☐ tertiary or trade.

Q18. Annual income before tax

☐ Less than $25,000 ☐ $25,000 to $50,000 ☐ $50,000 to $100,000

☐ more than $100,000

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